Ren, W., H. Tian, W.-J. Cai, S. E. Lohrenz, et al. (2016) Century-long increasing trend and variability of dissolved organic carbon export from the Mississippi River basin driven by natural and anthropogenic forcing, GBC, 30, 1288–1299.

Background: There has been considerable debate as to how natural forcing and anthropogenic activities alter the timing and magnitude of the delivery of dissolved organic carbon (DOC) to the coastal ocean. The objective of this work is to quantify DOC export from the Mississippi River to the Gulf of Mexico during 1901–2010 as influenced by changes in climate, land use and management practices, atmospheric CO_2, and nitrogen deposition.

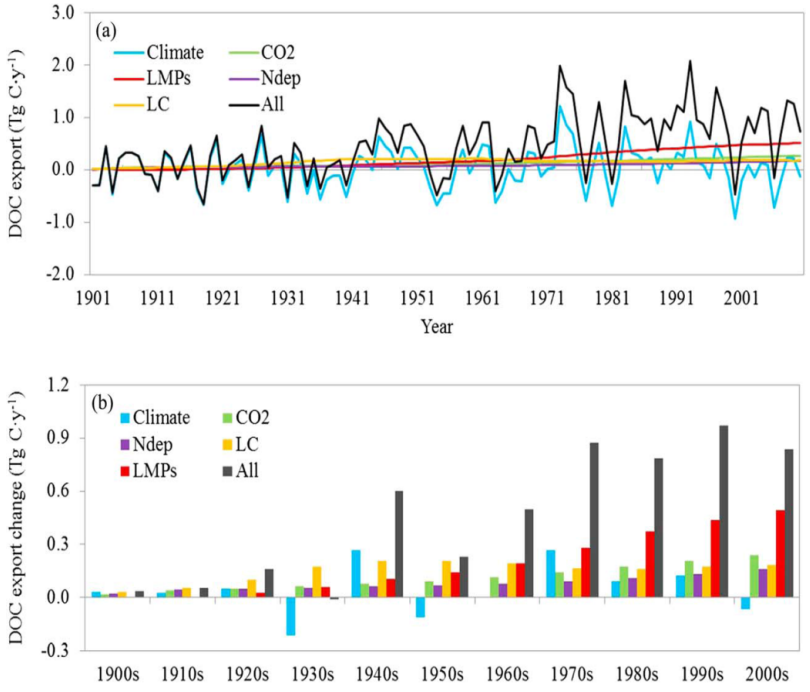
Method: We integrated ground- and satellite observations and historical data with the Dynamic Land Ecosystem Model (DLEM) to provide daily, spatially explicit estimates of carbon, nitrogen, and water fluxes from land to river and coastal ocean. Model-simulated DOC export is evaluated against observations from USGS gauging stations, and empirical estimates. Ten numerical experiments were designed to attribute DOC export to various driving factors.

Key findings:

1. Significant, long-term increases in both DOC concentration and export were found during 1901–2010. Mean annual export of DOC averaged over decadal intervals increased by over 40% from 1.8 ± 0.3 Tg C yr^{-1} in the 1900s to 2.6 ± 0.4 Tg C yr^{-1} in the 2000s. DOC concentrations in the estuary increased by approximately 70% over the study period.
2. Land management was responsible for 43% of the long-term increase in DOC export, while land conversion contributed another 33%. Land use and land management were the dominant contributors to the century-scale trend of rising total riverine DOC export. The changes in CO_2 concentration, Ndep, and Climate increased DOC export by 25%, 18%, and 9%, respectively.

Significance:

This is the first quantification of century-scale DOC export from the Mississippi river basin. And the changing trend of DOC was attributed to multiple anthropogenic and natural factors, which could provide useful information for designing mitigation strategies to reduce DOC export.



Changes in (a) annual DOC export and (b) decadal mean DOC export induced by climate change (Climate), atmospheric CO2, nitrogen deposition (Ndep), land cover change (LC), and land management (LMPs).

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